FRILO Software
A NEMETSCHEK COMPANY

DGK - Hip Rafter / Valley Rafter

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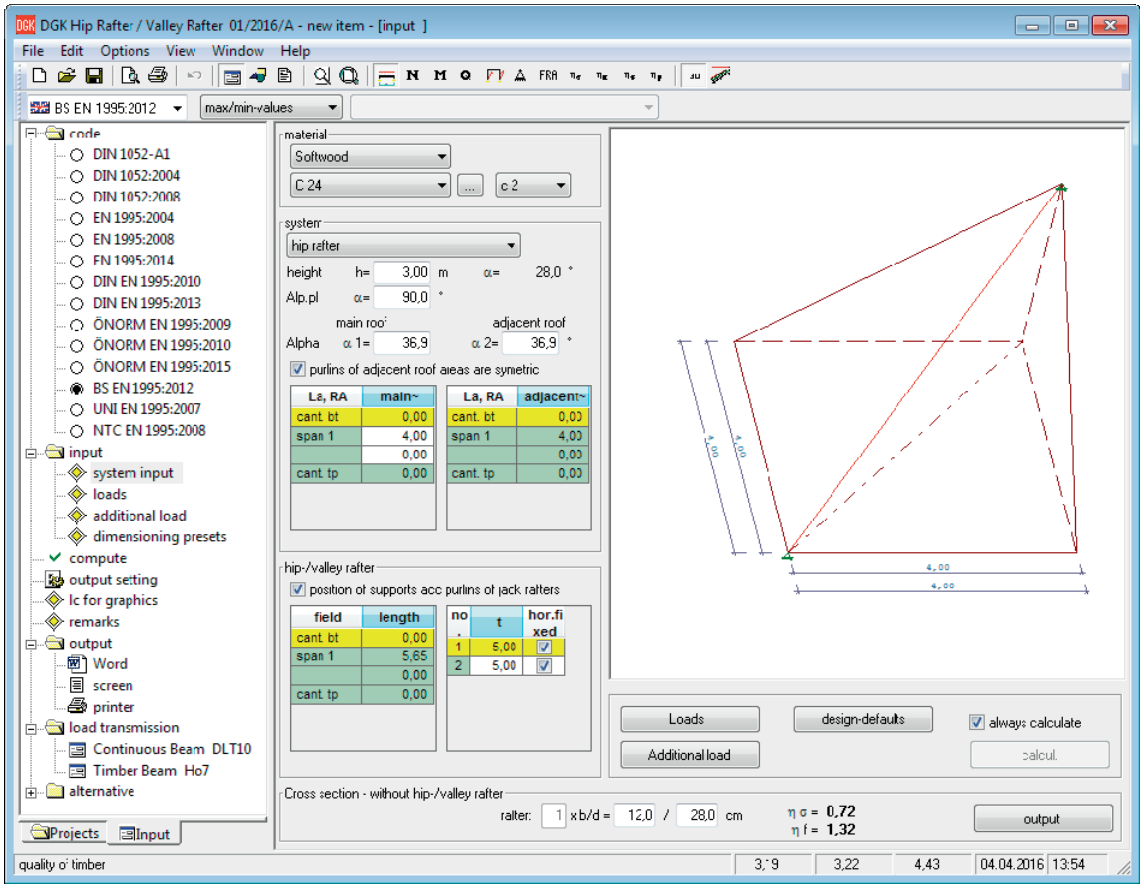

DGK – Hip Rafter / Valley Rafter

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Further information and descriptions are available in the relevant documentations:

FDC – Basic Operating Instructions	General instructions for the manipulation of the user interface
FDC – Menu items	General description of the typical menu items of Frilo software applications
FDC – Output and printing	Output and printing
FDC - Import and export	Interfaces to other applications (ASCII, RTF, DXF …)
FCC	Frilo.Control.Center - the easy-to-use administration module for projects and items
FDD	Frilo.Document.Designer - document management based on PDF
Frilo.System.Next	Installation, configuration, network, database

Application options

The application allows you to verify hip rafters and, optionally, valley rafters.

Available standards

- DIN EN 1995
- ÖNORM EN 1995
- BS EN 1995
- NTC EN 1995
- EN 1995
- EN 1991
- DIN EN 1991
- ÖNORM EN 1991
- NTC EN 1991
- DIN 1052
- DIN 1055-4/5

The calculation is performed in the same way as for a beam under bending stress. The verification of the cross-breaking strength is based on the assumption that the attached jack rafters have sway supports at the eaves side.

Variants:

- Single-span beam
- Multi-span beam
- Cantilevers on top/bottom
- Asymmetrical loaded areas are definable
- Loaded areas can be defined independently of supports
- Ground projections with angles other than 90° are also possible

As a standard, the software application computes hip/valley rafters of two adjacent roof areas the eaves of which are orthogonal to each other. The supports are assumed in the purlin contact points that coincide for both roof areas as a standard.

Optionally you can change these border conditions:

- The angle between the eaves in the projection may also be greater or smaller than 90 °.
- The purlins of the two adjacent roof areas can be arranged on different height levels, which means that a pair does not intersect the hip/valley rafter in a common point.
- The supports of the hip/valley rafter can be set independently of the purlins

The application determines triangular line loads from the roof loads g, s and w_d on the basis of the loaded areas. These loads are considered to apply to the hip/valley rafter. It is assumed that the jack rafters transfer primarily only vertical loads to the hip/valley rafter, which can, therefore, be verified in a uniaxial calculation.

You can design hip/valley rafters in accordance with EN 1995 while taking the combination rules as per EN 1990 into account. An action group number (AGN) and an associated load action period is assigned to the single load cases self-weight, snow and wind. The load-bearing capacity and the serviceability are checked in the verifications.

Geometry

The following dimensions must be defined as basic border conditions:

H = height of the hip/valley rafter

α_{GR} = inclination angle between the two eaves/ridges in the ground projection (GR).

α_1 = inclination of the primary roof

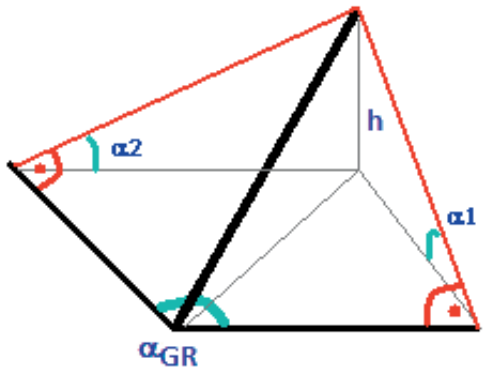
α_2 = inclination of the secondary roof

The following parameters are calculated automatically by the software:

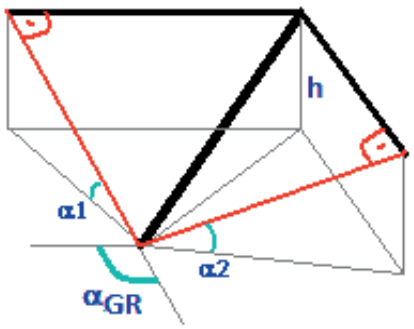
- the length of the outer edge of the jack rafters area and the length of the hip or valley rafter in the projection
- the lengths of the eaves or ridge sections up to the intersecting point with the outer edge of the jack rafters' area
- the length of the hip or valley rafter and its inclination

The other values are aligned to this frame geometry.

Hip rafter:



Valley rafter:

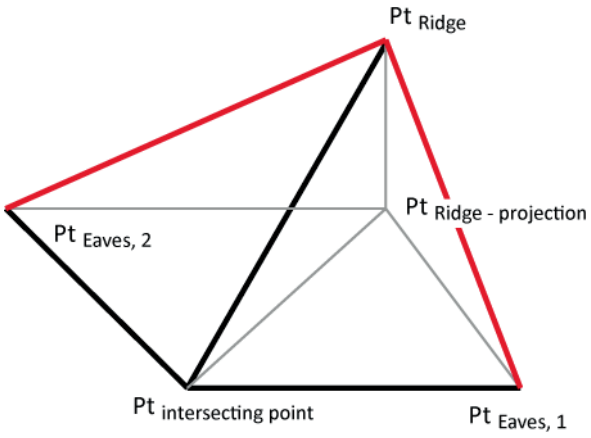


Border conditions:

Zero is the intersecting point (IP) of both eaves (base of the hip/valley rafter); the jack rafters are always perpendicular to the eaves/ridge. The coordinate axes x and y delimit the ground projection plane (z-axis = normal of the ground projection plane)

The following points are known from the basic parameters specified above:

- Ridge
- Projection of ridge in the ground plan
- Base of the hip/valley rafter
- Both intersecting points of the outer edge of the jack rafters' area with the respective eaves for hip rafters
- Both intersection points of the outer edge of the jack rafters' area with the respective ridge for valley rafters and their corresponding projection points in the ground plan.



Location of the purlins

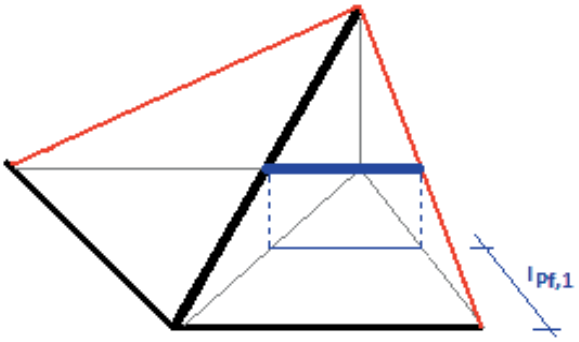
You can define purlins for both roof sides.

The purlins are defined by specifying the distance of the purlin to the eaves in the ground projection.

As a standard, the purlins of the secondary roof are arranged by the software application automatically in such a manner that they intersect in the same points on the hip or valley rafter.

Optionally, you can define the purlins of the secondary roof independently of the primary roof.

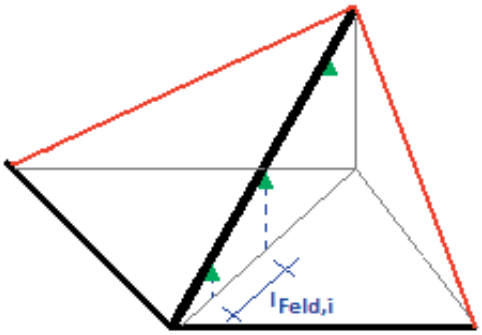
The location of the purlins is decisive for the calculation of the loaded areas and the loading on the hip/valley rafter.



Location of the supports of the hip/valley rafter

As a standard, the software assumes the supports at the intersecting points of the purlins with the hip or valley rafter.

You can optionally position supports individually and independently of the purlins, however.



Basis of calculation

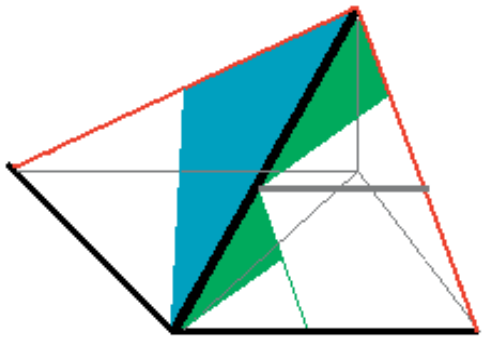
Load calculation

It is always assumed that each jack rafter transfers half of its loading to the next purlin and the other half to the hip/valley rafter.

The resulting loaded area is always triangular.

The triangle is defined by the bisectors of the angles between the hip/valley rafter and the eaves or the hip/valley rafter and the purlin.

If one or several centre purlins have been defined, additional triangular loads result.



The resulting load is calculated for the specific loaded area and distributed as a triangular load over the hip/valley rafter.

Hip rafter

Pre-factor *r*, *IP = intersection point*

$$r_1 = \frac{l_{Eaves,1} \cdot \frac{h_{Ridge}}{\tan\alpha_1} \cdot \frac{1}{2}}{\frac{h_{Ridge}}{\tan\alpha_{IP}}} \quad \text{or} \quad r_2 = \frac{l_{Eaves,2} \cdot \frac{h_{Ridge}}{\tan\alpha_2} \cdot \frac{1}{2}}{\frac{h_{Ridge}}{\tan\alpha_{IP}}}$$

The factors r_1 and r_2 provide for the "conversion" of the area loads to the hip rafter.

Permanent load:	$g_{IP,1} = g_1 \cdot r_1 \cdot \frac{\cos\alpha_{IP}}{\cos\alpha_1}$	and	$g_{IP,2} = g_2 \cdot r_2 \cdot \frac{\cos\alpha_{IP}}{\cos\alpha_2}$
Snow load:	$s_{IP,1} = s_1 \cdot r_1$	and	$s_{IP,2} = s_2 \cdot r_2$
Wind load:	$w_{IP,1} = w_1 \cdot r_1$	and	$w_{IP,2} = w_2 \cdot r_2$

There is no distinction of different aerodynamic areas available in connection with wind loads.

The maximum value is assumed as a uniform wind load instead. This value is editable.

Valley rafter

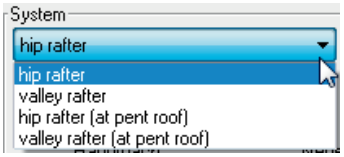
The calculation is done analogously to the hip rafter whereby the triangular load is assumed to decrease linearly.

Definition of the system

Material selection

Select the material (timber species and quality class/grading). In the calculation in accordance with DIN 1052:2004/2008 or Euro standards with a semi-probalistic safety concept, the usage class can be set in addition. Click on the ... button to access the corresponding dialog.

System



You can select either a hip rafter, a valley rafter or a pent roof variant via the displayed selections list.
The wind load assumptions for jack rafters of a pent roof differ from those for jack rafters of a gable roof.

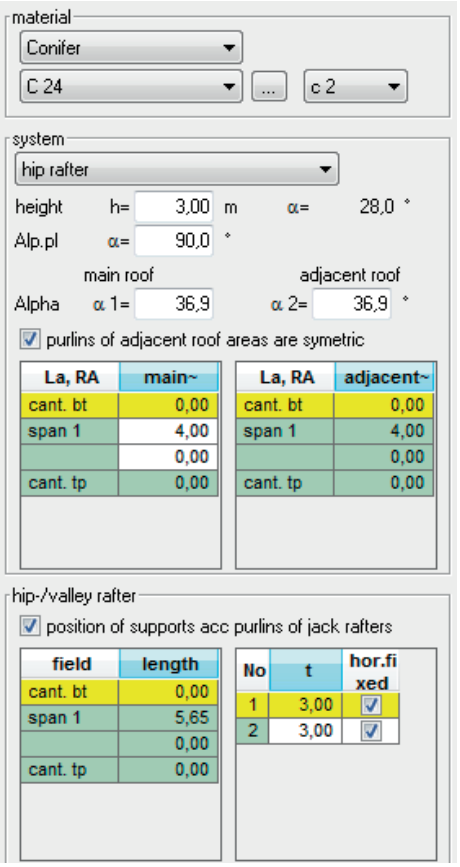
h = height of the roof or the hip/valley rafter

AlpGR = angle between the eaves in the projection

$\alpha 1$ = inclination of the primary roof

$\alpha 2$ = inclination of the secondary roof

α = inclination of the hip/valley rafter (only for information)



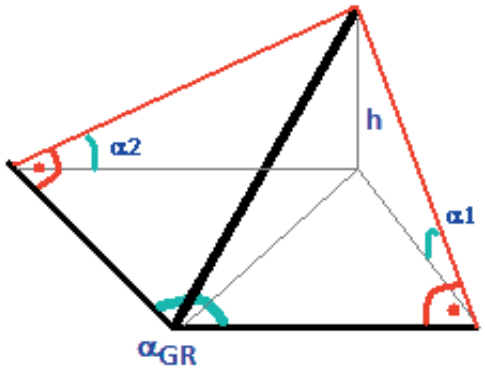


Illustration: System sketch of the hip rafter

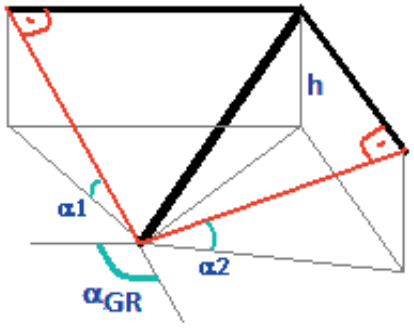
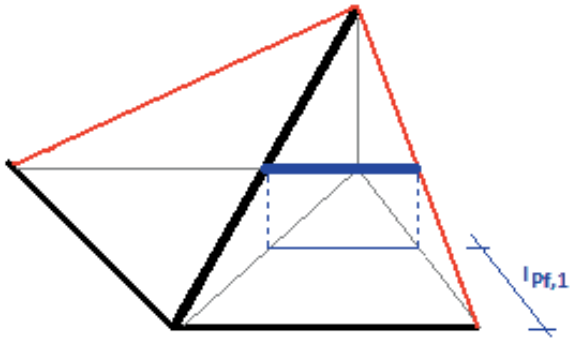


Illustration: System sketch of the valley rafter

Purlins

La = distance of the purlin in the projection of the jack rafters of the respective roof area

Symmetrical = if you check this option, the purlins of the secondary roof are arranged automatically in line with the purlins of the primary roof. Otherwise, you can freely arrange the purlins as via the input table on the right.



Supports

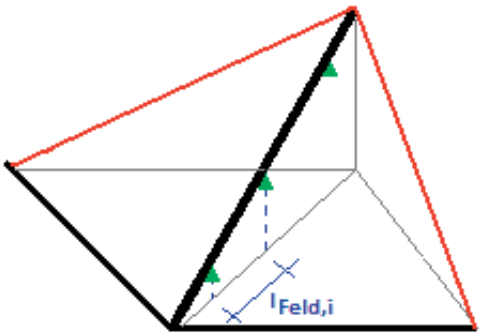
This option is enabled as a standard and the supports are automatically set at the intersecting points of the rafter with the purlins.

If you disable this option, you can freely position the support via the input table.

l = span length in the projection of the hip/valley rafter.

t = average birdsmouth depth

horizontally non-sway = if this option is enabled, the support is non-sway in horizontal direction.



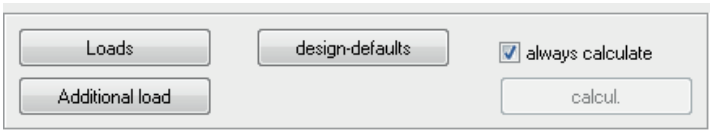
Cross section

When defining the cross-section, you need not specify the precise geometry of the hip or valley rafter but merely the rectangular (net) cross-section relevant for statics.

Loads, additional loads, calculation

The description of loads, additional loads, design options and the calculation applies to several software applications and is available in the document:

Roof: Loads_Design.pdf



Output

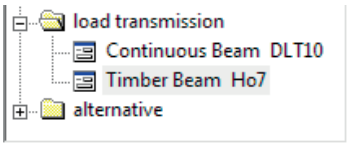
Output of the system data, results and graphical representations on the screen or the printer.
The Output item in the main menu allows you to start the output on a printer or the screen.

Word	output to MS-Word, if this software is installed on the computer.
Screen	displays the values in a text window on the screen
Print	starts the output on the printer

Load transfer to DLT and HO7

For the design of the purlins interfaces to the FRILO-applications

DLT Continuous Beam

HO7 Timber Beam

are implemented.